Autonomous Mobility Appliqué System Joint Capability Technology Demonstration

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- **COCOM Co-Sponsor:** TRANSCOM
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14. ABSTRACT

Integrate robotic technology onto Tactical vehicles to automate the driving task and reduce the mental and physical load on the operator allowing operator to focus on external threats and avoid vehicle accidents. The material solution would provide an Autonomous Mobility Appliqu? System (AMAS) comprised of a By-Wire kit and an Autonomy kit. The vehicle By-Wire kit will provide active safety functionality and the interface and actuation necessary to implement the Autonomy kits robotic capability. The Autonomy kit would provide scalable autonomy to include enhanced active safety functionality and leader/follower behaviors for convoy operations.

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Operational Problem Statement

- Current forces are facing an operational environment based on uncertainty, anti access and aerial denial threat tactics. This environment increases Soldier risk due to interdiction of US Lines Of Communication via hit-and-run and standoff attacks. As a result, these threats increase responsibility of drivers and passengers to maintain situational awareness along unsecured routes.

- Current Operating Environment requires service members to conduct logistic resupplies and operational patrols on specified Main Supply routes.
    - Inherit vulnerabilities that are hard to mitigate
    - Enemy forces are adapting to our convoy operational doctrine, TTPS, and SOPs
    - Speed and distance predictable to execute attacks against the convoys.
    - Majority of IED detection is done through visual means
        - Small Window of detection and evasive action

- Convoys are encountering environmental weather conditions that impact convoy operations leading to reduced logistics through-put and vehicle damage from on and off road accidents.
    - Convoys have been cancelled
        - Impacting Logistic and Operational patrols
    - Accidents due to fatigue and poor visibility
        - Human Limitations Restrict Effectiveness of Force.

- Current forces are operating and navigating vehicles alone over prolonged periods of time.
    - Increasing potential for accidents
    - Degradation of Performance
    - Task Overload

Increased Safety and Situational Awareness
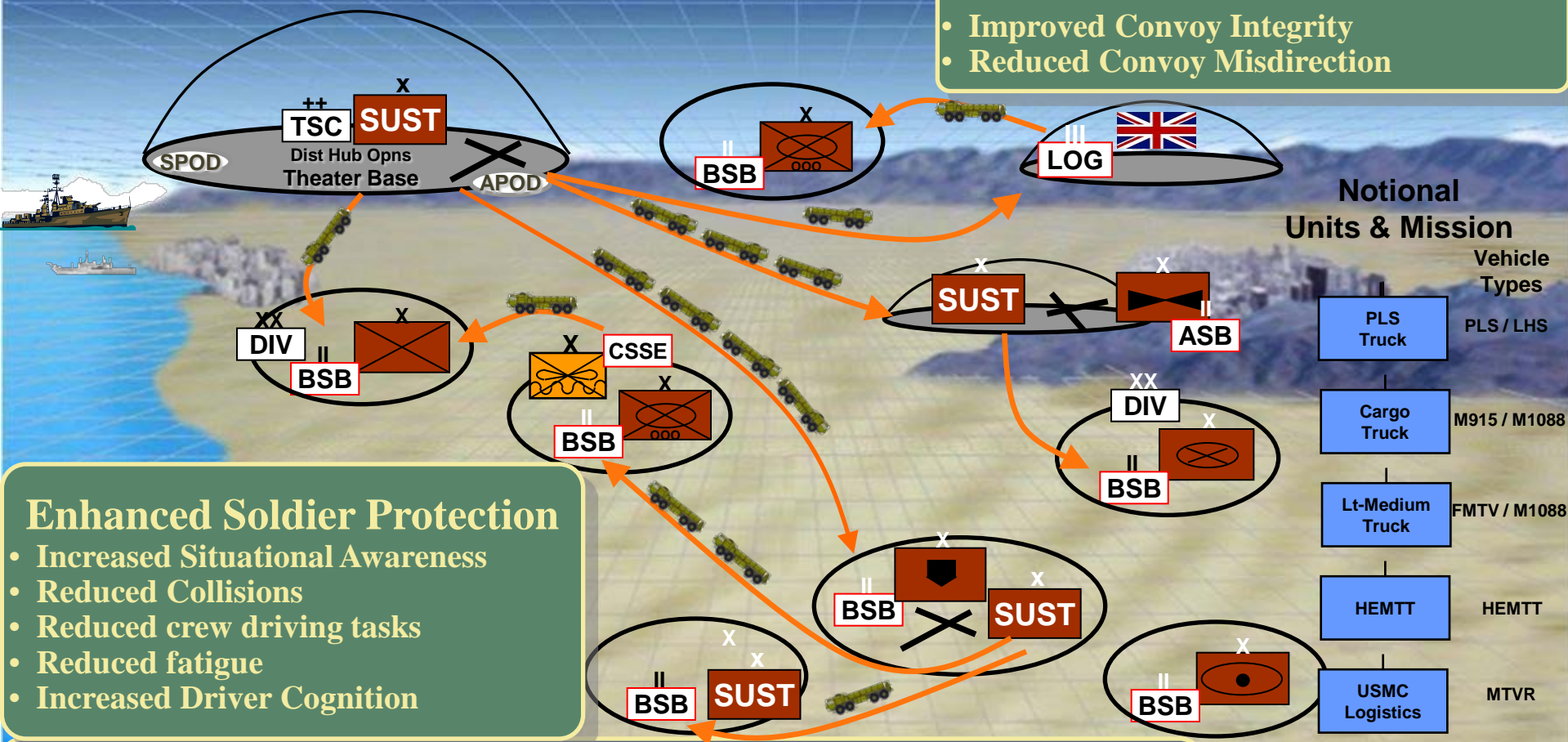
AMAS JCTD (OV-1)

Ground Distribution Benefits:
- **Improved Convoy Integrity**
- **Reduced Convoy Misdirection**

Notional Units & Mission

Vehicle Types

PLS Truck	PLS / LHS
Cargo Truck	M915 / M1088
Lt-Medium Truck	FMTV / M1088
HEMTT	HEMTT
USMC Logistics	MTVR
Distro Co BSB	M915 / M1088

SPOD — TSC — SUST — Dist Hub Opns Theater Base — APOD

BSB — LOG — SUST — ASB — DIV — BSB — CSSE — BSB — BSB — SUST — BSB — SUST — BSB — DIV — BSB

Enhanced Soldier Protection
- **Increased Situational Awareness**
- **Reduced Collisions**
- **Reduced crew driving tasks**
- **Reduced fatigue**
- **Increased Driver Cognition**

Objective - Improve soldier safety and battlefield distribution for the Ground Distribution fleet by using semi-autonomous Leader/Follower capabilities to increase crew situational awareness while reducing vehicle collisions and driver fatigue.

AMAS JCTD
Technical Overview

- **Integrate robotic technology onto Tactical vehicles to automate the driving task by providing scalable autonomy in a single material solution agnostic of platform.**
  - Autonomy Kit
    - Autonomous Hardware and Sensors
  - By-Wire/Active Safety Kit (BWASK)
    - Vehicle Specific Devices to Retrofit Current Tactical Vehicles
  - Common Interfaces
  - Common Framework

- **Scalable and flexible to address multiple task such as convoys, security, reconnaissance, sustainment, maneuver, maneuver support.**

- **Operational scenario using a secure mixed manned/unmanned platform convoy will demonstrate increased vehicle safety with high op tempo in complex conditions**
  - Year One Platforms – MTVR, M915 w/trailer
  - Year Two Platforms – MTV, PLS w/flatrack, HET w/trailer
  - OCP AST Support – MATV BWASK

- **Conduct Technical Demos and Operational Demo (CONUS): Demonstrate Driver Assist and Robotic Capabilities.**

AMAS JCTD Technical Approach

Year One

Integrate and Deploy Appliqué System:

- **Define and Integrate Appliqué System**
  - By-Wire/Active Safety Kits
  - 2 Each MTVR and M915 w/trailer
- **Capability**
  - Driver Assist/Active Safety Functionality
- **Technical Deliverables**
  - BWASKs on first 4 Vehicles
  - Open Architecture and Interfaces
  - Standardized Metrics and Test Procedures w/ATEC and MCCDC
  - LRU plug and play with limited adjustments

Year Two

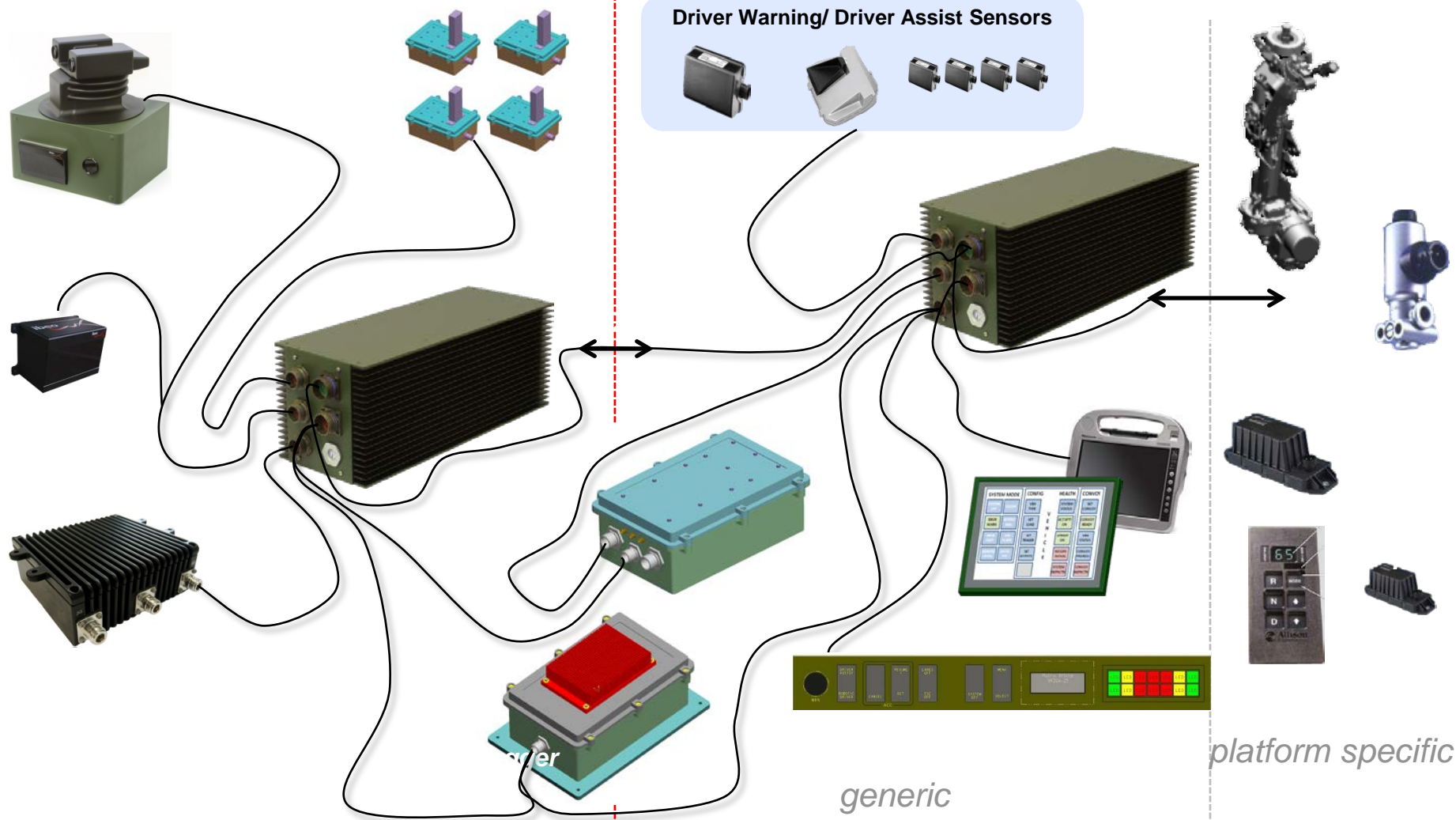**Increase levels of Autonomy and Expand Platforms:**

- **Extend Kit Capability**
  - 2 Each MTV, PLS w/flatrack and HET w/trailer
- **Increase Capabilities in Autonomy Kit**
  - Enhanced Driver Assist/Active Safety
  - Robotic Capability
- **Technical Deliverables**
  - Enhanced Autonomy Kit
  - Additional BWASKs
  - Scalable Autonomy
  - Improved Standardized Metrics and Test Procedures w/ATEC and MCCDC
  - Technical Specifications for Transition RFP
  - Framework for Validation of Realistic Requirements
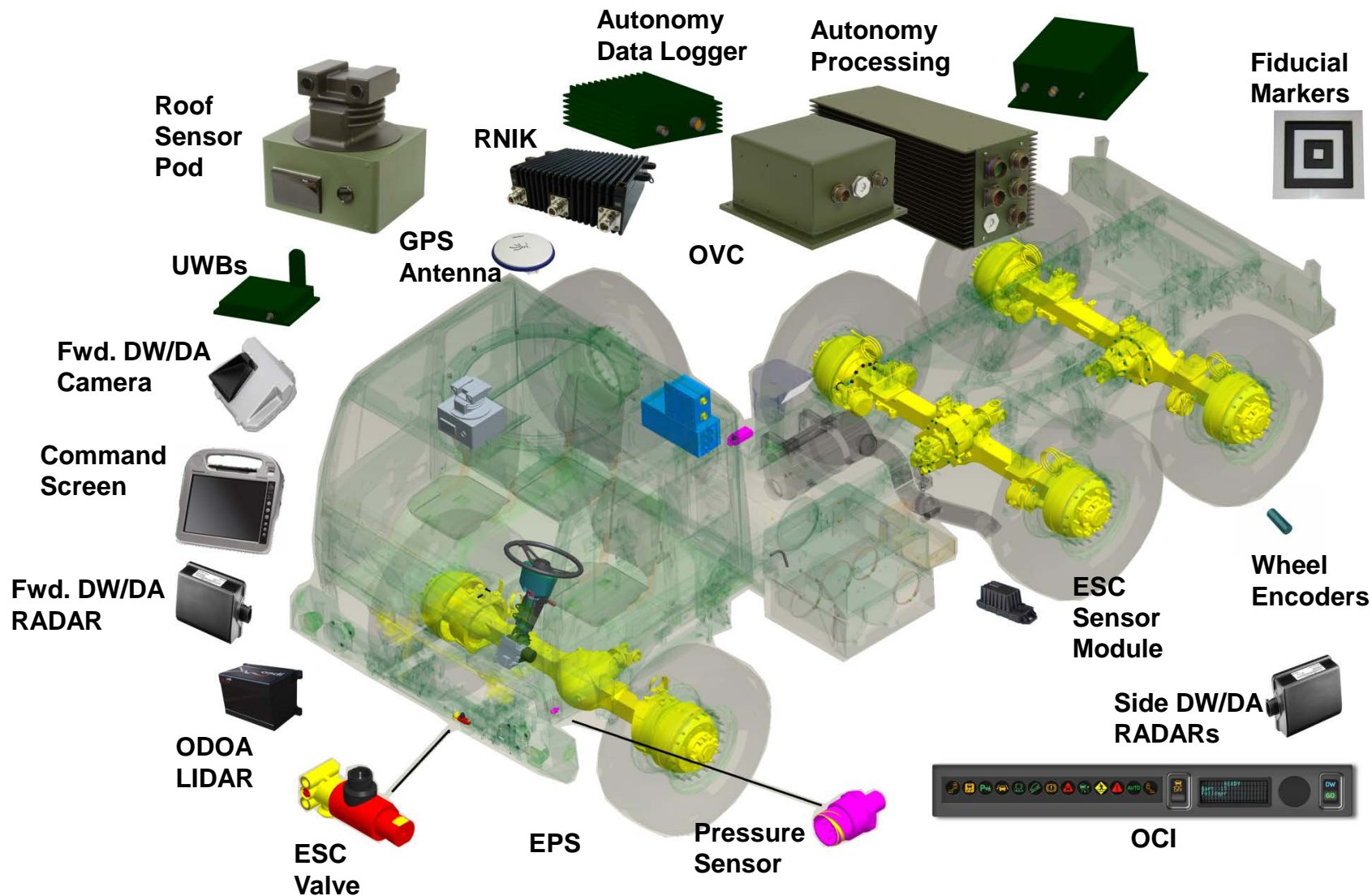
AMAS Hardware Concept

Autonomy Kit

By-Wire/Active Safety Kit

Driver Warning/ Driver Assist Sensors

platform specific

generic

UNCLASSIFIED

AMAS Notional Hardware Implementation

Autonomy Data Logger

Autonomy Processing

Fiducial Markers

Roof Sensor Pod

RNIK

UWBs

GPS Antenna

OVC

Fwd. DW/DA Camera

Command Screen

Fwd. DW/DA RADAR

ESC Sensor Module

Wheel Encoders

ODOA LIDAR

Side DW/DA RADARs

ESC Valve

EPS

Pressure Sensor

OCI

Scalable Autonomy

Level 1 Passive Safety	Level 2 Active Safety	Level 3 Convoy Behaviors	Level N Future (Enabled by JCTD)
Capabilities • Collision Warnings • Roll Over Warnings • Stability Control • Blind Spot Detection • Lane Departure Warnings	**Capabilities** • Lane Keeping • Collision Avoidance • Active Stability Control • Lane Change Assist • Adaptive Cruise Control	**Capabilities** • Leader/Follower • Remote Control • Waypoint Navigation • Convoy Intrusion • Convoy Rejoining	**Capabilities** • Teleoperation • Go To Point Nav • Dynamic Rerouting • Guided Vehicles • Collaborative Teaming
Pay-off • Improved Safety • Increase Capabilities of inexperienced Drivers • Increase Situational Awareness	**Pay-off** • Driver Augmentation • Improves Efficiency of Driver • Increased OpTempo	**Pay-off** • All Weather Operation • Increase throughput and efficiencies • Flexibility in convoy composition and routing	**Pay-off**(Mission Capabilities) • Perimeter Security • Route Clearance • Persistent Stare • Ordnance Detection • Decontamination

Overall Demonstration Strategy & Plan

Schedule

- **Year One: Refinement and Integration**
  - Develop Common Appliqué Kit
  - 1st Technical Demo Across Four Vehicles
    - 2 Each MTVR and M915 w/trailer.
  - Develop CONOPS / TTP and Finalize
- **Year Two: Operational Assessment and Transition**
  - 2nd Technical Demonstrations
    - Three Additional Platforms for 10 Total
      - 2 Each MTV, PLS w/flatrack and HET w/trailer
    - Integration of Lessons Learned
    - Begin ATEC Safety Release Process
  - Operational Demonstration
    - With Solders and Marines
  - Final Operational Demonstration Report

Tech Demonstrations and Operation Assessment

- **Convoy Operations**
  - Limited MSRs/ASRs
  - Long / Short Haul Duration
  - High Speeds/Low Speeds
- **Operating conditions**
  - Visibility/Terrain
  - Threat/Extreme Climates/Night Movements
- **Full Spectrum Operations**

Transition Strategy

AMAS JCTD Transition Paths:

1) Fieldable Prototypes

- Army Kits available for Extended User Evaluation (EUE) (after year 1 and year 2)

- Marine Corps vehicles available with integrated AMAS kits for EUE (after year 1 and year 2)

2) Spiral Software Capabilities to

- Husky Mounted Detection System PoR

- Route Clearance and Integration System PoR

3) SACO PoR

- Army is pursuing a Pre-MS A MDD to start the SACO PoR

> **The AMAS JCTD Provides capabilities across robotic Programs of Record while providing residuals for Warfighter use**

Summary

- **Technical Plan:**
  - Integrate robotic technology onto Tactical vehicles to automate the driving task and reduce the mental and physical load on the operator allowing operator to focus on external threats and avoid vehicle accidents. The material solution would provide an Autonomous Mobility Appliqué System (AMAS) comprised of a By-Wire kit and an Autonomy kit. The vehicle By-Wire kit will provide active safety functionality and the interface and actuation necessary to implement the Autonomy kits robotic capability. The Autonomy kit would provide scalable autonomy to include enhanced active safety functionality and leader/follower behaviors for convoy operations.

- **Demonstration Approach:**
  - 2 Technical Demonstration
  - 1 Operation Demonstration

- **Deliverables:**
  - Year 1: AMAS BWASKs w/common interfaces defined and driver assist capabilities.
  - Year 2: AMAS Kits applied to additional platforms and additional levels of autonomy.

- **Transition:**
  - FY14 with Milestone B and EMD Contract Award(s) OR CPD AROC/JROC Approval